

Modeling of Horns for Sonic/Ultrasonic Applications

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Abstract – JPL has a requirement for telerobotic tools for planetary sample acquisition, which require low power and have the ability to work in harsh environments. We are currently investigating the possibility of using ultrasonic horns to develop a family of ultrasonic tools for these environments. In an effort to determine control parameters a one-dimensional Mason's model for a stepped ultrasonic horn assembly was developed which includes the effects of mechanical and electrical losses in the piezoelectric material and acoustic elements. The model is separated into three regions; the piezoelectric stack including stress bolt the backing layer and the horn. The model is found to predict the impedance data of the horn assembly very accurately up to the first coupled (radial) resonance. The model also allows for the calculation of the velocity and force and power delivered to each acoustic element. FEM modeling and accelerometer data from the horn tip were used to corroborate the model. The difficulties associated with modeling the load impedance of various devices will be discussed and current directions noted.

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coring
in-situ sampling*